Small Business Innovation Research/Small Business Tech Transfer

Nanophotonic and Capillary Assisted Water Recovery, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

The current generation of spacecraft and terrestrial water recovery technologies are often prone to failures caused by biofouling and mineral scaling, which can clog mechanical systems and degrade the performance of capillary-based technologies. These failures require expensive and time-consuming maintenance and resupply, and the technologies are therefore limited to environments where these resources are available. Long duration spaceflight applications, such as extended stays at a Lunar Outpost or during a Mars transit mission, will increasingly benefit from water recovery hardware that is generally more robust and operationally sustainable over time, and that minimizes the impact of fouling and hardware failures.

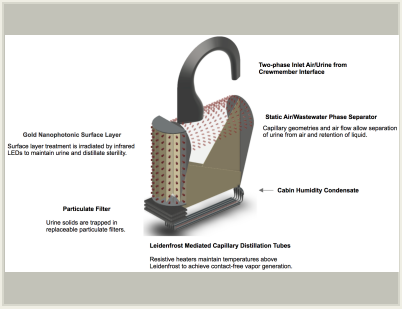
Our proposed water recovery concept takes advantage of the partial gravity on Mars or the lunar surface, while also being microgravity compatible. This will allow for a single water recovery system for both transit and planetary mission phases. This next-generation solid-state water recovery system for spacecraft will exploit a combination of advances in three areas of research, in order to manage wastewater recovery without rotating phase separators or chemical pretreatment. These research areas are:

1. Capillary geometries for passive phase separation;
2. Nanoparticle-enhanced pasteurization of urine wastewater through localized surface plasmon resonance in lieu of oxidizing pretreatment chemicals, thereby minimizing consumables; and
3. Leidenfrost-mediated fouling-free capillary distillation, accomplished in a heat pipe exceeding the Leidenfrost temperature to achieve contact-free vapor generation.

Anticipated Benefits

The Nanophotonic Capillary Distiller concept can be applied to a wide spectrum of spacecraft fluid management systems, for both short-term use and long-duration missions. The design will be adaptable to both microgravity and partial gravity environments, will target a 6-12 month transit period, operational periods in excess of 500 days, and a dormancy of two years or more.

Potential applications for uses other than with NASA missions include terrestrial wastewater management, water treatment and desalination in particular in remote, resource constrained environments.



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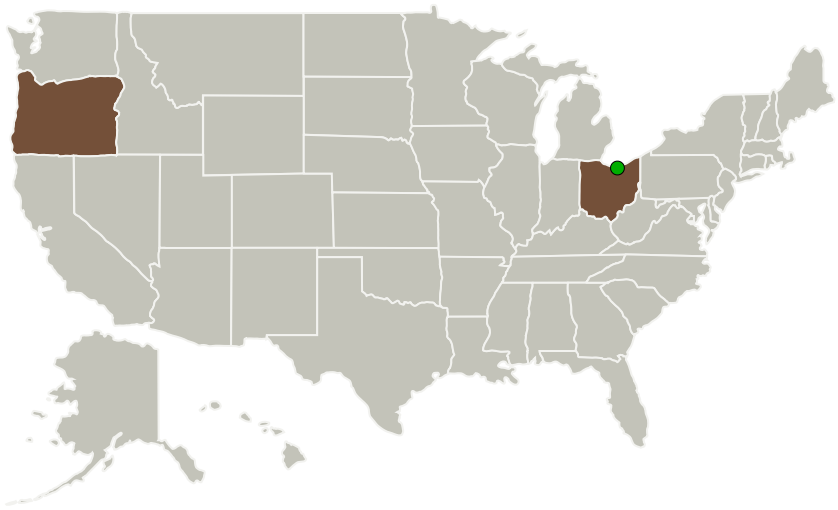
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
SweetSense, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Portland, Oregon
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Ohio	Oregon

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137870)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

SweetSense, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

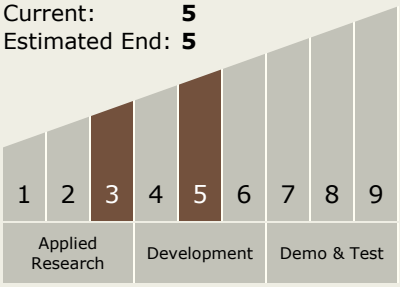
Carlos Torrez

Principal Investigator:

Evan Thomas

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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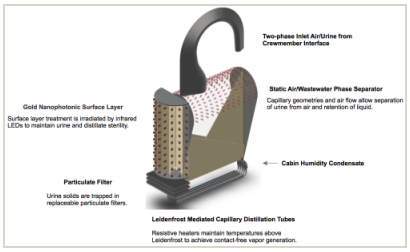
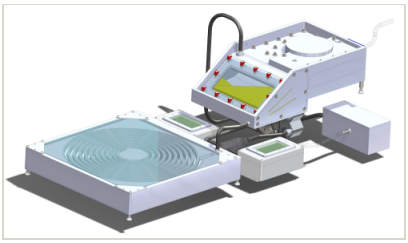
Images



Briefing Chart Image
Nanophotonic and Capillary Assisted Water Recovery, Phase I *(https://techport.nasa.gov/image/134005)*



Final Summary Chart Image
Nanophotonic and Capillary Assisted Water Recovery, Phase I *(https://techport.nasa.gov/image/134384)*

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.2 Water Recovery and Management

Target Destinations

The Moon, Mars, Earth